

ART. XIV.—*The Miocene Strata of the Gippsland Lakes Area.*

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(With Plate VII.)

The marine miocene in the neighbourhood of Jemmy's Point was described by one of us in 1890,<sup>1</sup> and it was then advised that further explorations should be made in order to determine more precisely the boundaries of the area occupied by such strata. Some work in this direction has since been done by Mr. W. Gregson and ourselves, the results of which are now given.

Soon after the publication of the previous article, a junction of the miocene and eocene strata was reported as visible at Swan Reach on the Tambo, but we did not closely examine the section till a few months ago on the occasion of a holiday trip to the Gippsland Lakes. A road-cutting on the eastern bank of the river, and about 100 yards south of the Punt Crossing at Swan Reach, has exposed a tolerable thickness of the marine tertiaries. A peculiar feature of the outcrop and that which distinguishes it from junctions of similar strata noticed elsewhere, is that certain characteristic fossils of the two horizons mentioned are apparently mingled promiscuously together on the face, instead of being strictly arranged in the order of their geological age. Before, however, any explanation of this is attempted, it will be necessary to give further details concerning the section.

Though individual specimens are fairly numerous, the actual number of miocene species represented is very small, the following being the only ones we could find :—

<i>Pecten antiaustralis.</i>	<i>Ostrea arenicola.</i>
<i>Pecten meringæ.</i>	<i>Cidaris</i> sp. (spines).
<i>Placunanomia ione.</i>	<i>Balanus amaryllis.</i>

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<sup>1</sup> Proc. Roy. Soc. Vic., 1891.

The two pectens named are not only abundant but they are also exceedingly well preserved, both valves being not infrequently still joined. *P. meringae* is restricted to the Gippsland miocene and, though so plentiful in the Swan Reach section, is in others within the area a rare shell. *P. antiaustralis* is common both at Muddy Creek and in the miocene of South Australia, but we have nowhere seen finer examples than some of those collected here.

One or two of the stronger eocene shells, as *Spondylus gacdero-poides* and *Pecten yahlensis*, though not as fresh looking as the miocene forms, are still in good condition, especially the latter, and they are besides the commonest of those found in the softer matrix, the eocene species generally, including also these two, being usually contained in nodules of limestone; for the most part the gastropods are represented by casts only, while with bivalves the tests are frequently preserved.

It may be remarked here that the miocene fossils obtained were all either lying loose on the face or embedded in the calcareous sand, while none were found as casts. We did not observe them in the limestone, though it would not have been unusual if such had been the case, since at Jemmy's Point there is plenty of miocene limestone, both fossiliferous and unfossiliferous; indeed, some of the limestone bands in the upper part of the Swan Reach section are probably of miocene origin.

On our first visit to the locality we collected only two or three species of eocene fossils and of these very few individuals, as we merely picked up those easily seen from their having partially or entirely weathered out from the matrix, but on another occasion a special search was made for them, and by breaking up the limestone towards the base of the section we got a tolerable number, a list of which is given below. As they are nearly all casts, comparatively few of them can be definitely determined specifically.

Scaphander tatei ?	Trochus sp.
Bullinella exigua ?	Dentalium sp.
Conus sp.	Ostrea hyotis ?
Voluta sp.	Gryphaea tarda ?

Siphonalia ? sp.	Dimya dissimilis.
Lotorium, two spp.	Pecten yahlensis.
Semicassis transenna ?	Spondylus gæderopoides.
Cassidaria sp.	Lima bassii.
Cypræa leptorhyncha.	Panopæa orbita.
Cypræa, two spp.	Casts of bivalves (indeterminate).
Tenagodes ocellus.	Waldheimia insolita.
Calyptræa sp.	Clypeaster gippslandicus.
Cerithium sp.	Placotrochus deltoideus ?
Natica subinfundibulum ?	
Natica sp.	

We are informed that bones of whales were found here when the cutting was made, and that they were sent to Professor McCoy, but we cannot vouch for the statement; we saw no signs of any.

As may be gathered from a preceding remark, the eocene shells are most frequent in the lower part of the section, and this is specially the case from the base to about two and half feet up, but they also occur, though more sparingly, at a higher level. Moreover, at the foot of the cliff we were unable to find miocene fossils by digging, though they are plentiful enough above, and show here and there on the face all the way down. At the height just mentioned, viz., two and a half feet up from the road, there is a layer of sandy clay, mixed with magnetic iron oxide and titaniferous iron, running horizontally along the section, and it is possible that this may mark the actual line of contact between the upper and lower beds. Certainly, the strata beneath it, which consist mainly of a tolerably compact limestone similar to that on the cliffs of the Mitchell River, furnished nearly all the eocene fossils on our lists.

The cutting is about eighty yards long and slopes gradually at either end. In its deepest part it measures about forty-two feet from the road at its foot to the summit, to which may be added twelve feet of alluvium on the river bank just below.

The following are approximate measurements of the strata, which are arranged in horizontal layers :

		Ft.	in.
	Surface soil - - - - -	10	0
	Gravel - - - - -	4	0
Miocene fossils.	{ Calcareous sandy clay with two or three bands of limestone -	25	0
	{ Band of sandy clay with ironstone gravel - - - - -	0	6
	{ Calcareous sandy clay with lime- stone full of casts of eocene fossils - - - - -	2	6
	{ Alluvium of river bank - - -	12	0
	Total - - - - -	54	0

The Tambo here is estimated to be only about four feet above sea level, though it is still at a considerable distance from its mouth at lake Victoria. The tide reaches at least thus far up the river, its marks being visible at the Punt.

Though the Swan Reach section is not, as will be shown later on, the most westerly outcrop of the miocene strata of the area, the deposits appear to thin out in that direction, whereas to the east they make strongly, and at Jemmy's Point, with those portions reckoned only which are certainly fossiliferous, a thickness of at least fifty or sixty feet is apparent. It marks also almost the northern boundary of the miocene, since as the Tambo is followed up for a short distance, the river cliffs which consist of hard limestone (the so-called polyzoal rock), are of eocene age. They form a part of, and are probably continuous with, the Bairnsdale limestones, which are, as is well known, characteristically eocene.

That a junction of the miocene and eocene strata is presented in the Swan Reach section is clear enough, and the only difficulty is as to how the intermingling of the shells in the manner described was brought about. Our theory concerning the section is that it represents a re-made bed, the eroded surface of eocene strata having formed the floor of the miocene beach. The limestone blocks containing casts of eocene fossils which lie beneath the ferruginous band, are probably *in situ*, while the casts and worn shells, which are mixed with well preserved miocene forms higher up, may be regarded as *derived* from the waste of the ancient shore line. The two eocene bivalves *Pecten yahlensis* and

*Spondylus gæderopoides*, would, from their solid structure, be less liable to injury than most other species, and this, no doubt, accounts for their occasional occurrence in the miocene sands as fairly perfect specimens; that they came originally from the limestone is undoubted, since not only did we find examples in the blocks broken up, but they are also common fossils in similar rocks on the eocene cliffs close at hand.

The re-arrangement of materials in a junction bed is of course common enough. For example, just *in* the nodule band at Muddy Creek, both eocene and miocene fossils are found, the latter predominating, while below it a few small miocene forms pass down into the older bed, and above, some proper to this transgress into the younger.

The presence of so few miocene species in the Swan Reach section is certainly remarkable, and can only be accounted for on the supposition that they were almost the only ones ever deposited on that particular portion of the old miocene beach. In the Gippsland miocene the distribution of species is doubtless partial, but this feature is nowhere else so marked as in the present section.

That the miocene in other parts of the area is also underlain by eocene strata may be reasonably inferred. To the north on the Nicholson and Tambo Rivers, the higher ground is occupied by eocene strata, which also crop out to the west at Bairnsdale, and again to the east on Lake Tyers. Though they are not seen between the latter locality and Swan Reach, there can be little doubt that they exist at no great depth beneath the miocene throughout the intervening distance.

In his "Notes on the Mitchell River Division," Mr. Howitt describes a set of beds which fill in a deeply excavated area at the contact of the Bairnsdale limestones and the Avon sandstones.<sup>1</sup> The beds here referred to overlie, as Mr. Howitt points out, the Mitchell River limestones at Boggy Creek and elsewhere. They are best known as the Moitun Creek beds, and consist of ferruginous sandstones, etc., containing casts of marine fossils, the precise age of which has not yet been conclusively decided. Some hundredweights of highly fossiliferous material have been

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<sup>1</sup> Prog. Report Geol. Survey of Vic., No. II.

lately gathered at one of the outcrops near Bairnsdale, and now await examination.

A few forms can be easily made out, but others are obscure, and can only be determined by means of plaster moulds, which we have not yet had time to prepare. We therefore abstain just now from offering any opinion upon the actual relationship of these ferruginous beds to those discussed in the present paper, though we hope to be in a position to place our views before the Society at an early date.<sup>1</sup>

Allusion has already been made to outcrops of the miocene between Swan Reach and Bairnsdale. The most westerly of these is on the roadside close to the Nicholson River. But few fossils could be found, and all were very friable. They comprise the following species :—

<i>Bullinella paucilineata.</i>	<i>Nuculana</i> aff. <i>N. Woodsii</i> .
<i>Turritella tristira.</i>	<i>Tellina æquilatera.</i>
<i>Dentalium</i> sp.	<i>Cucullæa corioensis.</i>
<i>Chione</i> sp.	<i>Trigonia acuticostata.</i>
<i>Corbula ephamilla.</i>	<i>Cardita spinulosa</i> ?
	<i>Cidaris</i> sp. (spines).

At Slaughterhouse Creek, about half way between the Nicholson and Tambo, the following were gathered, but they were also very poorly preserved :—

<i>Dentalium</i> sp.	<i>Placunanomia ione.</i>
<i>Ostrea arenicola.</i>	<i>Corbula ephamilla.</i>
<i>Pecten antiaustralis.</i>	<i>Waldheimia</i> sp.
<i>Pecten meringæ.</i>	
And many indeterminable fragments.	

Both of these are insignificant deposits, and are only mentioned on account of their position which is apparently just upon the fringe of the Jemmy's Point miocenes.

Southwards from Swan Reach on the shores of Reeves River at Meringa Creek, and Kalimna, a large collection was made in 1890, and these localities need not now be referred to. The other collecting grounds indicated on the map yielded numerous

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<sup>1</sup> Since writing the above the fossils have been sufficiently examined to enable us to recognise the ferruginous beds as miocene.

species, but no special interest attaches to any of the outcrops. One of the best sections for fossils is that at Lake Bunga, where they are both plentiful and well preserved.

On the coast at the Red Bluff, and also between there and Lake Bunga, there is a great thickness of stratified calcareous sandstone overlain by clay and gravel wash, all unfossiliferous though probably also of miocene age. Similar unfossiliferous sandstones overlie the fossil bearing beds near Jemmy's Point, and form cliffs of about the same height, viz., from 50 feet up to 200 feet. No contact of the miocene with the adjoining eocene of Lake Tyers was observed; the most easterly locality noted as a collecting station is not far from Red Bluff, which is thus close to the *apparent* eastern boundary of the miocenes. Their disappearance in this direction is abrupt, since at Lake Bunga they show no signs of thinning out. It is possible indeed that, although they have not so far been observed, they may crop out again in places farther eastward. Certainly they are not seen on the road to Orbost, and the beds at Hospital Creek and on the Snowy River are characteristically eocene.

Inland, at Christopher Ritches', on the Mississippi Creek, the shells are exposed in a road cutting, from which, among the usual species, several not collected elsewhere in the area have at different times been obtained. As this creek is followed northwards the beds gradually thin out and disappear, while still further north, trappean rocks only were seen.

In crossing one of Ritches' paddocks near the Creek, we noticed the shells among the grass as if they had been turned up by the plough. Similarly at Roadknight's they show on some rising ground in earth thrown out of wombat holes. On the northern shores of the lakes almost every landslip discloses them in abundance, while the quarries and road cuttings in the vicinity frequently expose the fossiliferous sands and clays. The deposits are thus wide spread, and probably extend over a great part, if not the whole, of the area included between the approximate northern boundary of the miocene as marked on the map and the Lakes' margin; on the higher ground they are hidden from view by a moderate covering of pliocene and still later drifts. This boundary, which we have of course merely sketched out by connecting the several outcrops, would, if it could be accurately



traced under the overlying sediments, represent the former outline of the miocene coast, only, instead of being nearly a straight line, it might perhaps prove to be as much broken by indentations as the present northern shores of the lakes.

Appended is a list of the species obtained from the various sections in the area since the publication of the previous article. In all, fifty-one additional species are here recorded, which bring up the total number now known from the beds to 167. A large proportion of the more recent gatherings are, so far, restricted to these beds; seven of the species are also constituents of the miocene fauna of Muddy Creek, while three or four, if not more, are still living in the adjoining seas.

Many of the new species here referred to are very handsome, and we hope before long they will be described in the Proceedings of the Society; among them are included a fine large volute, two elegant mangilias, one or two new tritons, a trigonostoma, new species of marginella, and a markedly distinct species of the curious little coral, for which the genus *Trematotrochus* was established by Tenison Woods.

In the former publication, the proportion of recent species of mollusca was estimated at sixteen per cent., and by omitting, as was done before, a few in the present list which are too worn for accurate identification, the percentage remains practically the same; it is certainly not increased.

The opportunity is now taken of making some necessary corrections in the 1890 list, as indicated in the columns below:—



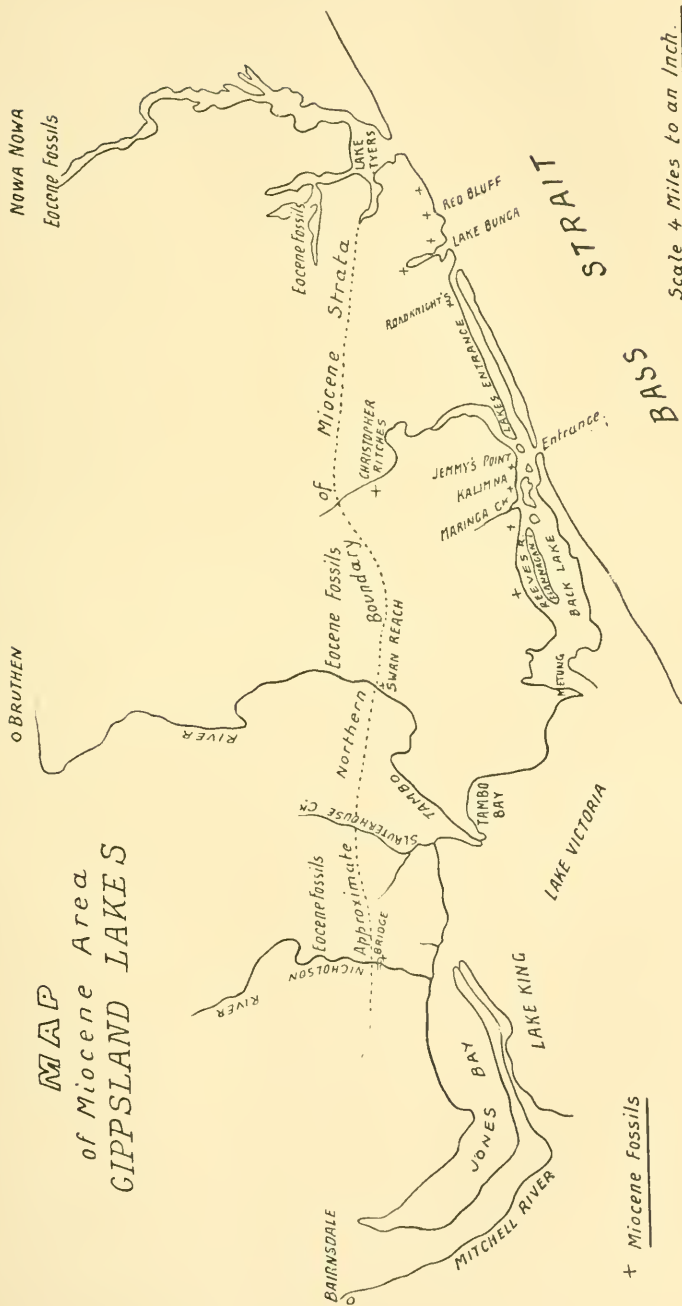
(Corrections of former List marked with dagger; names in italics under "Remarks" are those previously quoted).

Species in Gippsland Miocene.	Eocene.	Miocene.		Remarks.
		Muddy Creek.	South Australia.	
Actæon sp.	-	-	-	( <i>aff.</i> A. funiculifer, Mioc., Muddy Ck.)
Terebra sp.	-	-	-	New species.
Conus hamiltonensis, Tate-	*	*	-	
Bathytoma sp.	-	*	-	( <i>aff.</i> D. sandleroides).
Drillia trevori, T. Woods	*	-	-	New species.
Drillia sp.	-	-	-	New species.
Drillia sp.	-	-	-	New species.
Drillia two spp.	-	-	-	New species.
Mangilia two spp.	-	-	-	New species.
Cancellaria sp.	-	-	-	New species.
Trigonostoma sp.	-	-	-	( <i>aff.</i> M. strombiformis).
Marginella sp.	-	-	-	( <i>aff.</i> M. tuberculosa).
Marginella sp.	-	-	-	( <i>aff.</i> unnamed sp., Mioc., Muddy Ck.)
Marginella sp.	-	-	-	New species.
Turricula sp.	-	-	-	( <i>aff.</i> T. schonburgki).
Voluta sp.	-	-	-	New species ( <i>aff.</i> V. fusiformis).
Voluta sp.	-	-	-	( <i>aff.</i> V. conoidea).
Fasciolaria sp.	-	-	-	

ADDITIONS AND CORRECTIONS TO CATALOGUE OF FOSSILS (*continued*).

Species in Gipsland Miocene.	Miocene.		Remarks.
	Eocene.	Muddy Creek, South Australia.	
<i>Fusus</i> sp. -	-	-	New species.
<i>Latirus purpureoides</i> , <i>Tate</i> -	-	*	
<i>Tudicula</i> sp. -	-	-	
<i>Gomella</i> sp. -	-	-	
<i>Phos</i> sp. -	-	-	(aff. <i>C. crebricostata</i> ).
<i>Columbella</i> sp. -	-	-	
<i>Trophon</i> sp. -	-	-	Living Southern Australia.
<i>Purpura succincta</i> , <i>Martyn</i> -	-	-	
<i>Lotorium apicinum</i> , <i>Tate</i> , <i>m.s.</i> -	-	-	New species.
<i>Lotorium</i> sp. -	-	-	(aff. <i>L. verrucosum</i> ).
<i>Lotorium</i> sp. -	-	-	New species (aff. <i>B. granarium</i> ).
<i>Bittium</i> sp. -	-	-	
† <i>Turritella tristira</i> , <i>Tate</i> -	*	-	
† <i>Turritella conspicabilis</i> , <i>Tate</i> -	*	-	
† <i>Turritella pagodula</i> , <i>Tate</i> -	-	*	<i>Turritella</i> sp.
† <i>Calyptrea crassa</i> , <i>Tate</i> -	-	-	
<i>Calyptrea</i> sp. -	-	-	<i>Sigapatella undulata</i> .
† <i>Crepidula unguiformis</i> , <i>Lane</i> -	*	*	<i>C. monoxyla</i> and <i>C. immersa</i> ; living Southern Australia.
† <i>Natica cunninghamensis</i> , <i>Harris</i> -	-	*	
			<i>Nom. mut.</i> , <i>N. varians</i> , <i>Tate</i> , non <i>Dugardin</i> ; <i>N. gibbosa</i> .

MAP  
of Miocene Area  
GIPPSLAND LAKE S



+ Miocene Fossils

Scale 4 Miles to an Inch.